

2. (Amended) The plane diffraction grating according to claim 1, wherein the plane diffraction grating is a blazed type, and a blaze angle θ_0 of the grooves in an area along an original line at the azimuthal angle $\phi = 0$ which is perpendicular to the grooves is set as:

$$\theta_0 = \frac{\alpha + \beta}{2},$$

where α is an angle of an incident ray from a normal to the surface of the plane diffraction grating in the area, and β is an angle of a diffraction ray from the normal, and a blaze angle θ_ϕ of the grooves in an area along a line at the azimuthal position is set as

$$\sin \theta_\phi = \sin \theta_0 \sqrt{\frac{1 + \tan^2 \phi}{1 + \tan^2 \phi \sin^2 \theta_0}}.$$

3. (Amended) The plane diffraction grating according to claim 2, wherein:

the surface of the plane diffraction grating is covered with a multiple-layer coating to improve reflectivity;

a unit thickness db_ϕ of the multiple-layer coating in the area along the original line at the azimuthal angle $\phi = 0$ satisfies the equation:

$$m_b \lambda = 2d_{b\phi} R_{\alpha\phi} \cos(\alpha - \theta_0)$$

where

m_b is the diffraction order,

λ is the wavelength of the light diffracted by the area,

$$R_{\alpha\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \alpha},$$

$$\delta_\phi = 1 - n_\phi,$$

n_ϕ is the average refractive index of the multiple-layer coating

and an unit thickness $d_{b\phi}$ of the multiple-layer coating in the area along the line at the rotational position ϕ satisfies the equation:

$$m_b \lambda = 2d_{b\phi} R_{\alpha\phi} \cos(\alpha - \theta_0),$$

where

λ is the wavelength of the light diffracted by the area

$$R_{\alpha\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \alpha},$$

$$\delta_\phi = 1 - n_\phi$$

n_ϕ is the average refractive index of the multiple-layer coating.

4. (Amended) The plane diffraction grating according to claim 1, wherein the plane diffraction grating is a laminar type, and a depth h_ϕ of the grooves in an area along a line at the azimuthal angle ϕ is set as

$$h_{[\phi]} = \frac{\lambda_{[0]}}{2(\cos \alpha + \cos \beta)},$$

where λ is the wavelength of the light diffracted by the area, α is an angle of an incident ray from a normal to the surface of the plane diffraction grating in the area, and β is an angle of a diffraction ray from the normal.

5. (Amended) The plane diffraction grating according to claim 4, wherein:

the surface of the plane diffraction grating is covered with a multiple-layer coating to improve reflectivity;

a unit thickness db_ϕ of the multiple-layer coating in the area along the line at the azimuthal angle ϕ satisfies the equation:

$$m_b \lambda = d_{b\phi} (R_{\alpha\phi} \sin \alpha + R_{\beta\phi} \sin \beta),$$

where

m_b is the diffraction order,

$$R_{\alpha\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \alpha}, \quad R_{\beta\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \beta},$$

$$\delta = 1 - n_\phi,$$

n_ϕ is the average refractive index of the multiple-layer coating,

and

an unit thickness $db\phi$ of the multiple-layer coating in the area along the line at the rotational position ϕ satisfies the equation:

$$m_b \lambda = d_{b\phi} (R_{\alpha\phi} \sin \alpha + R_{\beta\phi} \sin \beta),$$

where

λ is the wavelength of the light diffracted by the area

$$R_{\alpha\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \alpha}, \quad R_{\beta\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \beta},$$

$$\delta_\phi = 1 - n_\phi,$$

n_ϕ is the average refractive index of the multiple-layer coating].

6. (Twice Amended) An optical system comprising:

a plane diffraction grating having grooves on a surface of the plane diffraction grating whose profile at an area is determined depending on a azimuthal position ϕ of the area about a rotational center defined as a foot of a rotational axis which is normal to the surface;

a mechanism for rotating the plane diffraction grating about the rotational axis;

an incidence optical system for casting a converging beam of light on a point of the

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surface of the plane diffraction grating, the point being apart from the rotational center.

7. (Amended) The optical system according to claim 6, wherein the plane diffraction grating is a blazed type, and a blaze angle θ_0 of the grooves in an area along an original line at the azimuthal angle $\phi=0$ which is perpendicular to the grooves is set as:

$$\theta_0 = \frac{\alpha + \beta}{2},$$

where α is an angle of an incident ray from a normal to the surface of the plane diffraction grating in the area, and β is an angle of a diffraction ray from the normal, and

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a blaze angle θ_ϕ of the grooves in an area along a line at the azimuthal position ϕ is set as:

$$\sin \theta_\phi = \sin \theta_0 \sqrt{\frac{1 + \tan^2 \phi}{1 + \tan^2 \phi \sin^2 \theta_0}}.$$

8. (Amended) The optical system according to claim 7, wherein:
the surface of the plane diffraction grating is covered with a multiple-layer coating to improve reflectivity;

a unit thickness db_ϕ of the multiple-layer coating in the area along the original line at the azimuthal angle $\phi = 0$ satisfies the equation:

$$m_b \lambda = 2d_{b\phi} R_{\alpha\phi} \cos(\alpha - \theta_0),$$

where

m_b is the diffraction order,

λ is the wavelength of the light diffracted by the area,

$$R_{\alpha\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \alpha},$$

$$\delta_\phi = 1 - n_\phi,$$

n_ϕ is the average refractive index of the multiple-layer coating.

9. (Amended) The optical system according to claim 6, wherein the plane diffraction grating is a laminar type, and a depth h_0 of the grooves in an area along an original line at the azimuthal angle ϕ is set as

$$h_\phi = \frac{\lambda}{2(\cos \alpha + \cos \beta)},$$

where λ is the wavelength of the light diffracted by the area, α is an angle of an incident ray from a normal to the surface of the plane diffraction grating in the area, and β is an angle of a diffraction ray from the normal.

10. (Amended) The optical system according to claim 9, wherein:
the surface of the plane diffraction grating is covered with a multiple-layer coating to improve reflectivity;
a unit thickness $d_{b\phi}$ of the multiple-layer coating in the area along the line at the azimuthal angle ϕ satisfies the equation:

$$m_b \lambda = d_{b\phi} (R_{\alpha\phi} \sin \alpha + R_{\beta\phi} \sin \beta),$$

where

m_b is the diffraction order,

$$R_\phi = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \alpha}, \quad R_{\beta\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \beta},$$

$$\delta_\phi = 1 - n_\phi,$$

n_ϕ is the average refractive index of the multiple-layer coating

11. (Twice Amended) A method of producing a plane diffraction grating having grooves on a surface thereof whose profile at an area is determined depending on a azimuthal position ϕ of the area about a rotational center defined as a foot of a rotational axis, the method comprising the steps of:

coating a substrate with a photo-resist layer and forming a photo-resist mask from the photo-resist layer according to a preset pattern of groove arrangement;

covering the photo-resist mask with a sector mask having an opening of a narrow sector whose apex is set at the rotational center;

etching the substrate over the sector mask with an appropriate etching condition depending on a rotational position of the sector mask about the rotational center;

rotating the sector mask by an angle of the apex of the narrow sector; and

repeating the etching process and the mask rotating process until the narrow sector sweeps the surface of the substrate.

12. (Amended) The plane diffraction grating producing method according to claim 11, wherein the plane diffraction grating is a blazed type, and the etching condition in the etching process is such that:

a blaze angle θ_0 of the grooves in an area along an original line at the azimuthal angle $\phi = 0$ which is perpendicular to the grooves is set as

$$\theta_0 = \frac{\alpha + \beta}{2},$$

where α is an angle of an incident ray from a normal to the surface of the plane diffraction grating in the area, and β is an angle of a diffraction ray from the normal, and

a blaze angle $\theta\phi$ of the grooves in an area along a line at the azimuthal position ϕ is set as

$$\sin \theta_{\phi} = \sin \theta_0 \sqrt{\frac{1 + \tan^2 \phi}{1 + \tan^2 \phi \sin^2 \theta_0}}$$

13. (Amended) The plane diffraction grating producing method according to claim 12, wherein the surface of the plane diffraction grating is then covered with a multiple-layer coating to improve reflectivity, and:

a unit thickness db_{ϕ} of the multiple-layer coating in the area along the original line at the azimuthal angle $\phi = 0$ satisfies the equation:

$$m_b \lambda = 2d_{b\phi} R_{\alpha\phi} \cos(\alpha - \theta_0),$$

where

m_b is the diffraction order,

λ is the wavelength of the light diffracted by the area,

$$R_{\alpha\phi} = \sqrt{1 - (2\delta\phi - \delta\phi^2) / \cos^2 \alpha},$$

$$\delta\phi = 1 - n_{\phi},$$

n_{ϕ} is the average refractive index of the multiple-layer coating

14. (Amended) The plane diffraction grating producing method according to claim 11, wherein the plane diffraction grating is a laminar type, and the etching condition in the etching process is such that:

a depth h_{ϕ} of the grooves in an area along a line at the azimuthal angle ϕ is set as

$$h_{\phi} = \frac{\lambda_{[0]}}{2(\cos \alpha + \cos \beta)},$$

where λ is the wavelength of the light diffracted by the area, α is an angle of an incident ray from a normal to the surface of the plane diffraction grating in the area, and β is an angle of a diffraction ray from the normal,

15. (Amended) The plane diffraction grating producing method according to claim 14, wherein the surface of the plane diffraction grating is then covered with a multiple-layer coating to improve reflectivity, and:

a unit thickness db_ϕ of the multiple-layer coating in the area along the line at the azimuthal angle ϕ satisfies the equation

$$m_b \lambda_\phi = d_{b\phi} (R_{\alpha\phi} \sin \alpha + R_{\beta\phi} \sin \beta),$$

where

m_b is the diffraction order,

$$R_{\alpha\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \alpha}, \quad R_{\beta\phi} = \sqrt{1 - (2\delta_\phi - \delta_\phi^2) / \cos^2 \beta},$$

$$\delta = 1 - n_\phi,$$

where n_ϕ is the average refractive index of the multiple-layer coating.